Ontario Geological Survey

Northern Ontario Engineering Geology Terrain Study 60

HERON BAY AREA

(NTS 42D/NE)

District of Thunder Bay

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By

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MAP
(accompanying report)

Map 5093 (coloured) – Northern Ontario Engineering Geology Terrain Study, Data Base Map, Heron Bay (NTS 42D/NE). Scale 1:100 000.

Northern Ontario
Engineering Geology Terrain Study 60

HERON BAY AREA

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John F. Gartner[1]

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Heron Bay area, District of Thunder Bay. The area, which covers NTS block 42D/NE, lies between Latitudes 48°30'N and 49°00'N and Longitudes 86°00'W and 87°00'W. This report forms part of a series of publications which provide similar terrain data for some 370 000 km^2 of northern Ontario.

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5093, accompanying this report).

Interpretation of existing black and white aerial photographs, at scales of approximately 1:54 000, was the primary method of obtaining this ter-

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rain information. The interpretation was checked with published and unpublished literature which documented previous field visits and observations. During the summer of 1978, roads in the area were traversed and observed terrain conditions recorded as further verification of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further information on the mapping techniques, legend format, and possible uses of this information is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed, in preparation), a companion publication to this series of maps and reports.

2.0 GEOLOGICAL SETTING:

2.1 BEDROCK:

Massive and rugged bedrock hills dominate the landscape along the north shore of Lake Superior. Relief in excess of 150 m is common, and slopes on the sides of the hills are complex and steep. The view over the lake from some of these hills is of unusual beauty.

The Port Coldwell alkalic complex, located between the Pic and Little Pic Rivers on the north shore of Lake Superior, is about 325 km^2 in area. As such, it is one of the largest occurrences of this type of complex in northwestern Ontario. Mafic igneous rocks form the rim of this complex (Carter *et al.* 1973; Milne *et al.* 1972).

Severely faulted metasediments and metavolcanics form a belt about 12 km wide along the shoreline, from McKellar Harbour to Jackfish Bay. These same rock types are found along the Pic River and Black River, but in these areas they are largely covered by glaciolacustrine deposits.

The remainder of the map area is underlain by felsic igneous and metamorphic rocks.

The alkalic complex has medium potential for the occurrence of uranium and the rare earth elements, with "marked radioactivity" being noted in parts of the body (Springer 1978). An area, roughly corresponding to the mafic igneous rocks which form the rim of the alkalic complex, has a high potential for base and platinum metals. Mineral potential of the metasediments and metavolcanics is rated as medium, particularly for the base and platinum metals, while that of the felsic igneous rocks is rated as least to unknown.

2.2 QUATERNARY:

The map-area has been significantly affected by glaciolacustrine and glaciofluvial processes during the last 10,000 years. Varved silt and clay occur in valleys far inland from Lake Superior, while other valleys are filled with sand and gravel.

During deglaciation, a series of glacial lakes, known as the post-Minong Lake stages, occupied the Lake Superior basin. As the ice front retreated northwards, the valleys of the Pic, Little Pic, Black and White Rivers were inundated by these lake waters. The varved clay and silt found in these valleys were deposited during these lake stages. Zoltai (1967) suggests that most of the massive silt and silty clay in the Pic River area were deposited in Houghton Lake, a later stage of the post-Minong Lakes.

As deglaciation proceeded, the extent of the glacial lakes began to diminish. The embayment up the Pic River system retreated, and the waters became shallow. Meltwaters flowing down from the ice front entered these receding lake embayments, and with time, the environment changed from one of deep water estuarine deposition to a more fluvial environment of moving, shallow water. Evidence of these changing conditions is found in the sediments of the Pic River valley, where stratified and cross-bedded sand of fluvial origin overlies thick deposits of varved clay.

In the Marathon area, there is a massive granular landform that has been identified as an ice contact delta (Cowan 1976). Zoltai (1967) suggested a morainal origin for at least part of this landform. The deposit has been modified by glaciolacustrine processes, resulting in the development of beaches and terraces.

Another delta, of glaciolacustrine origin, occurs at Jackfish Bay, where the spillway following the Steel River emptied into the glacial lake southwest of Santoy Lake.

3.0 ENGINEERING TERRAIN UNITS:

3.1 BEDROCK:

3.1.1 Description:

Bedrock knobs (RN) are the dominant terrain unit. Overburden is less than 1 m thick, and many of the rock knobs are bare. In some cases, the overburden becomes thicker on the flanks of and between the bedrock hills. Relief is high, often greater than 150 m, and slopes are steep and complex. This combination of conditions produces some of the most spectacular scenery to be seen in Ontario. A typical terrain unit symbol is:

$$\frac{\text{RN(tMG/R)}}{\text{Hj-D}}$$

This shows rock knob terrain (RN) to be the dominant landform. The letter symbols (tMG/R) indicate that glacial till ground moraine can be found within the terrain unit, as a veneer overlying bedrock. The relief is rugged and high (Hj), and the surface is dry (D).

3.1.2 Significance:

RESOURCES: Portions of the rock can be used for crushed stone purposes, but detailed evaluations of suitability for aggregate use would be required. Ground water resources within the bedrock will be limited to fractures, faults, and fissures. The occurrence of aquifers is unpredictable and the terrain has only fair potential for ground water supplies. The rugged natural beauty of the landscape and the great number of scenic vantage points could be considered a valuable resource of this area.

GENERAL CONSTRUCTION: The major constraint in terms of construction and development is the presence of massive, irregular and

complexly sloping bedrock outcrops. Because of the general lack of overburden, almost any type of development will require blasting and rock grading. This will increase construction costs and necessitate the use of rock fills or the importation of suitable soil fills. Foundation conditions should be excellent on the bedrock, but the steep and complex slopes can present problems in the siting of structures. Route alignments will be difficult to locate, and extensive blasting and filling will likely be necessary to maintain design criteria grades.

The shallow drift cover, combined with the massive and complex bedrock outcrops, makes development activities difficult and expensive. Also, management of the land for any development would be complex. The variable and steep rock slopes, covered with only a thin veneer of drift, will make the terrain sensitive to surface erosion, especially when cleared of vegetation.

WASTE DISPOSAL: The bedrock terrain is generally unsuitable for the disposal of waste, whether it be garbage, septic tank effluent, or industrial liquid waste. Development of lagoons or tile fields would require extensive grading of rock material and importation of soil fill. Fractures in the bedrock could act as conduits for migration of effluents, and the impact on surface drainage courses could be significant.

3.2 GLACIOFLUVIAL LANDFORMS:

3.2.1 Description:

Outwash (GO) landforms are scarce in this map-area. There are only two deposits of any significance: one along the Steel River north of Santoy Lake, and the other along the Little Pic River near the north-central boundary of the map-area. In both of these deposits, the material is a gravelly sand, and the surface is dry. They are described, respectively, by the terrain unit symbols:

$$\frac{\text{sgGO}}{\text{Lt-D}} \qquad \frac{\text{sgGO}}{\text{Lp-D}}$$

Outwash sometimes occurs in conjunction with glaciolacustrine sediments, as represented by the symbol:

$$\frac{sLP,sGO}{Lt\text{-}D}$$

In such cases there is evidence of both glaciolacustrine and glaciofluvial processes. Further site-specific work would be necessary to determine the exact origin, and relative importance of the two terrain types.

An *ice-contact delta* (GD) is present in the Marathon area. Cowan (1976) gives a good description of this landform, and the present mapping generally corresponds with his findings. The upper part of the delta is planar and composed of sand and gravel. Distinct kettle holes occur in the eastern part of the landform, and the material is somewhat coarser than in the western part. Shallow lake waters have modified the western part of the delta, and lacustrine beach deposits cover its surface at lower elevations.

Water well logs provide some clue as to the thickness of the deposit and the general stratigraphy. Two wells in the town of Marathon intersect bedrock at 40 and 50 m below ground surface. The logs show 8 to 15 m of sand, silt, and bouldery sand overlying 32 to 35 m of stratified sand, silt, and clay. Near the northern limits of the landform, adjacent to Highway 17 and the airstrip, the delta is only 10 to 20 m thick.

Typical map symbols depicting this terrain unit are:

$$\frac{sgGD}{Lut\text{-}D} \qquad \frac{gsGD}{Mk\text{-}D}$$

3.2.2 Significance:

RESOURCES: There is good potential for the occurrence of commercial sand and gravel deposits within these landforms. However, the deposits are not common, and areas of potential aggregate supply are located only 1) in the Marathon ice-contact delta, 2) along the Steel River north of Santoy Lake, and 3) along the Little Pic River near the north-central boundary of the map-area.

The large ice-contact delta at Marathon contains useable quantities of ground water; a number of wells have been developed within the land-

form. Other glaciofluvial landforms in the map-area have a poorer ground water potential due to their limited size and depth.

GENERAL CONSTRUCTION: Construction within these landforms should encounter no problems. Excavations are feasible with normal equipment, and dewatering is unlikely, at least in shallow excavations. Foundations for structures should be adequate. Materials can be easily handled and compacted.

WASTE DISPOSAL: Normal septic system designs should function properly within these landforms, but site-specific investigations are necessary.

The siting of landfills or the disposal of liquid wastes within the glaciofluvial landforms is not encouraged. There is a good possibility of direct hydraulic connection between the surface and aquifers at depth. Thus, conditions would be favourable for contaminant migration. The siting of any waste disposal facilities will require detailed hydrogeological studies to better define any potential problems.

3.3 GLACIOLACUSTRINE LANDFORMS:

3.3.1 Description:

A *glaciolacustrine delta* (LD) is present at Jackfish Bay; Zoltai (1967) indicates that lacustrine sediments occur at a maximum elevation of about 300 m above sea level. The existence of kettle holes suggests that glaciofluvial activities also contributed to the formation of this landform. It is mapped as

$$\frac{\text{sgLD/R}}{\text{Lpk-D}}$$

since bedrock is suspected to be near surface in some areas.

Glaciolacustrine plains (LP) occupy most of the river valleys of the Little Pic, Pic, White, and Black River systems. These sediments have been described by a number of previous investigators, including Thomson (1931), Farrand (1960), Milne (1967, 1968), and Coates (1970). All of these

investigators remarked on the great thickness of these deposits and the characteristic stratigraphy, in which strata of sand and silt overlie varved clay.

Milne (1967) described four sample locations along the Pic River. The sections range up to 46 m in thickness and have anywhere from 3 to 6 m of silty sand overlying the clay. The clay is varved in most cases, consisting of alternating layers of silt and clay.

The sand, silt and clay are very susceptible to erosion, and the unit is characterized by its dissected appearance and unstable banks. Owing to the continuous slumping of these banks, the rivers have a characteristic muddy appearance due to the high sediment load carried by the water. In fact, the Pic River derived its name from this appearance, Pic meaning "muddy" in Ojibwayan (Thomson 1931).

Typical symbols depicting this terrain unit are:

$$\frac{\text{smLP}}{\text{Ld-M}} \qquad \frac{\text{smcLP}}{\text{Md-M}}$$

Glaciolacustrine beaches (LB): A number of beaches have developed upon other landforms. These beaches occur near the present shoreline of Lake Superior 1) east of Jackfish Bay, where arcuate beach ridges are visible on the airphotos, and 2) at Marathon, where beach sand and gravel have been identified (Cowan 1976) and beach scarps are evident south of the town.

Typical terrain unit symbols are:

$$\frac{\text{sgLB/sgLD}}{\text{Mt-D}} \qquad \frac{\text{sgLB}}{\text{Ms-D}} \qquad \frac{\text{gsLB}}{\text{Lu-M}}$$

3.3.2 Significance:

RESOURCES: The delta south of Santoy Lake and the beach ridge materials in the Marathon area have potential as sand and gravel resources. Although pits have already been developed in these deposits, site-specific investigations are advised if further resources are required.

The varved clay in the area has limited commercial potential. As described by Milne (1967, p.56), "The commercial value of the Pic River clays is restricted to drain and tile manufacture or as an additive in brick manufacture".

Ground water resources may exist beneath the deep clay sediments, especially if porous sand and gravel overlie the bedrock. However, in general, the probability of finding ground water is rated as only fair.

GENERAL CONSTRUCTION: There would be no serious constuction problems within the delta (LD) and beach (LB) deposits. However, the thick glaciolacustrine sediments, consisting of sand, silt and clay (smcLP), have very poor engineering characteristics. The occurrence of silty sand overlying varved clay and silt produces a number of problems, such as

1) instability along river banks or on man-made cuts,
2) erosion and gullying with resultant siltation of drainage courses,
3) difficulties in earth movement operations and subsequent compaction of fill,
4) low bearing strengths for footings and foundations,
5) frost-susceptible soils which could affect pavement designs and backfill operations.

WASTE DISPOSAL: Septic tile field designs must contend with impermeable soils and, occasionally, poor drainage conditions. These problems will be mitigated where adequate thicknesses of sand overlie the clay or where delta and beach deposits occur.

Solid waste disposal facilities may lack suitable fill materials, and care must be taken to protect surface water conditions. Where deeper deposits of sandy materials are found, contaminant migration problems must be investigated.

The disposal of liquid wastes in lagoons is possible, but construction could be complicated by the existence of surface sand and poorly drained silty soil.

3.4 ALLUVIAL AND ORGANIC LANDFORMS:

3.4.1 Description:

Alluvial plains (AP) can be found bordering every drainage course, but only the more significant ones are shown on the map. The Steel River alluvial plain appears to be very sandy and meanders are well developed, while the other alluvial plains consist of finer grained silty sand to sandy silt. The landforms are often wet and level, and the rivers carry a high silt load because of the erodible nature of the sediments. In some cases, organic materials are associated with these alluvial plains. Typical map symbols depicting this terrain unit are:

$$\frac{\text{sAP(sgGO)}}{\text{Lp-M}} \qquad \frac{\text{smAP(pOT)}}{\text{Lp-Mh}}$$

Organic terrain (OT) is scarce and occurs as small pockets between massive bedrock hills. It also appears as a veneer overlying other materials, but there are no extensive deposits. Typical terrain unit symbols are:

$$\frac{\text{pOT/smLP,sGO}}{\text{Lu-W}} \qquad \frac{\text{pOT/tMG/R}}{\text{Lu-W}}$$

3.4.2 Significance:

Organic and alluvial landforms have exceedingly poor engineering characteristics. Thus, they are generally rated as poor or very poor for almost all uses. If flood plains or swamps must be disturbed by any human activities, then detailed investigations are essential to minimize impact and provide data for engineering design.

4.0 SUMMARY OF ENGINEERING SIGNIFICANCE:

The preceeding section described the characteristics of the major landform types and the engineering and resource significance of these units. Table 1 is a summary of the general engineering significance of the more common terrain units found in the area. This table is intended only as

a guide to help the reader in assessing the overall significance of the map units. Site-specific work is necessary to better define actual ground conditions. Also, it must be realized that there are a number of conditions, such as drainage and slope, which are not considered in the table but which may affect the engineering significance of the various terrain units.

TABLE 1 SUMMARY OF ENGINEERING SIGNIFICANCE.

		BEDROCK	GLACIOFLUVIAL		GLACIOLACUSTRINE			ALLUVIAL	ORGANIC
		RN	sgGO	sgGD	sgLD/R	smcLP	sgLB	smAP	pOT
RESOURCE POTENTIAL	Sand & Gravel	Poor	Excellent	Excellent	Excellent	Poor	Excellent	Very Poor	N/A
	Ground Water	Poor	Fair	Good	Fair	Fair	Fair	Poor	Poor
LIGHT CONSTRUCTION CONDITIONS	Excavation	Blasting	Good	Good	Fair	Fair	Good	Poor	Poor
	Foundation	Excellent	Good	Good	Good	Poor	Good	Poor	Very Poor
	Grading	Difficult	Good	Good	Fair	Poor	Good	Poor	Very Poor
	Material Re-Use	Rockfill	Excellent	Excellent	Good	Poor	Good	Poor	Very Poor
WASTE DISPOSAL	Septic	Very Poor	Good	Good	Fair	Fair	Fair	Very Poor	Very Poor
	Landfill	Poor	Poor	Poor	Poor	Fair	Poor	Very Poor	Very Poor
	Lagoons	Very Poor	Poor	Poor	Poor	Fair	Poor	Very Poor	Very Poor

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42-D-1	Prairie River Bridge
42-D-4	Steel River Bridge
42-D-7	Big Pic River Bridge
42-D-11	Big Pic River Bridge
42-D-12	Big Pic River Bridge
42-D-10	Pic River, Hwy. 627

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